

Index

- AAC, 3
- Anscombe transformation, 139
- atom, 2, 3
- basis pursuit, 157, 186, 198, 212
- beamlet transform, 287, 290, 294
- Bessel function
  - first kind, 351
  - spherical, 351
- biorthogonal
  - 3-dimensional, 277, 278
  - Haar, 141
  - wavelet, 26
- blind source separation, 234
- Bonferroni correction, 129
- BSS, 234
  - NMF, 258
- $C^2$ , 216
- $C^2$ – $C^2$  functions, 114
- Cartesian coronization, 307
- cartoon, 215
- cirrus, 84
- closing, 84
- CMB, 368
- coherence, 241, 376
- color images, 153
- complex wavelet transform, 51
- compressed sensing, 1, 223
- continuous wavelet transform, 5, 16, 21
- contourlet, 115
- contrast enhancement, 116
- cosine transform, 6
- Cosmic Microwave Background, 368
- cross-validation, 131
- curvelet, 336
  - contrast enhancement, 116
  - sphere, 336
- curvelet transform, 7, 94
  - first generation, 105, 106
  - first generation 3D, 296
  - second generation, 109, 113
- cycle-spinning, 201
- Dantzig selector, 186
- data
  - aggregate, 14
  - Barbara, 4, 120, 122, 151, 153, 220, 226, 257
  - boat, 102
  - boats, 255, 261
  - boy-texture cartoon, 219, 221
  - chirps, 194
  - CMB, 368
  - color, 153
  - comet, 11
  - Derry, 13
  - drum, 261
  - Earth, 344
  - echocardiograph, 11
  - EEG–MRI, 233
  - Einstein, 28, 50, 56, 75
  - ERS, 8
  - Gemini/OSCIR, 215
  - Hale-Bopp, 78
  - harbor, 261
  - Herschel/PACS, 384
  - IRAS, 84
  - ISO, 88
  - landscape, 13
  - Lena, 13, 31, 40, 42, 204, 227
  - lines and Gaussians, 228
  - lines and points, 214
  - Logan-Shepp phantom, 207
  - mammogram, 13
  - Mars topography, 332
  - Marseille port, 118

426 Index

- data (*cont.*)
  - Mondrian, 389
  - NGC 2997, 57, 58, 87
  - ophthalmology, 78
  - P/Swift-Tuttle, 11
  - peppers, 152
  - Phase transition, 388
  - plasma confinement, 367
  - SAR, 8
  - Saturn, 119
  - SeaWiFS, 8
  - sines and spikes, 232
  - spike train, 195
  - synchrotron, 341, 343
  - tubulin filaments, 150
- dB, 50
- DCT, 3
- deconvolution, 8
  - combined deconvolution, 205
- denoising, 200
  - combined denoising, 200
- dictionary, 2, 3, 4, 200, 216
  - learning, 245
- dictionary learning, 263
  - K-SVD, 268
  - MOD, 268
  - patch, 265
  - sparse coding, 266
- dilation, 82, 83, 93
- dyadic analysis, 87
- edge
  - detection, 219
  - enhancement, 116
- EEG, 231
- erosion, 82, 84, 93
- false detection rate, 129
- filter bank, 24
- Fisz transform, 140
- fMRI, 231
- Fourier transform, 5, 23, 70, 73
  - short-time, 5
- frame, 45
  - tight, 45
- fusion physics, 365
- Gabor transform, 5
- gamma-ray burst, 140
- Gaussianity, 238
- Haar
  - undecimated, 59
  - wavelet, 20, 33
  - wavelet transform, 59, 81, 140, 217
- HEALPix, 322
- hybrid steepest descent, 132, 203
- hypothesis test, 126
- ICA, 234, 236
- ICF, 365
- incoherence, 7, 208, 374, 376
- independent component analysis, 234, 236
  - FastICA, 235
  - higher order statistics, 238
  - InfoMax, 238
  - JADE, 235
  - sparsity, 240
- inertial confinement fusion, 365
- inpainting, 155, 222, 318, 342
  - sphere, 342
- integer wavelet transform, 80
- isotropic wavelet transform, 53, 279
- iterative
  - hard thresholding, 188, 206, 244, 245, 247
  - reconstruction, 64, 131
  - soft thresholding, 186, 244, 245, 247
  - thresholding, 64, 131, 186, 203
- James-Stein rule, 136
- JPEG, 3
- JPEG 2000, 25, 28, 29
- K-SVD, 268
- Kullback-Leibler, 237
- Lasso, 158
- lifting scheme, 32
  - mathematical morphology, 84
- Littlewood-Paley decomposition, 22
- m-term approximation, 39, 105, 109, 114
- MAD, 128
- Mallat's multiresolution, 6, 24, 27
- Mars Orbiter Laser Altimeter, 331
- mathematical morphology, 82
  - closing, 84
  - dilation, 82, 83
  - erosion, 82, 84
  - infimum, 83
  - opening, 84
  - supremum, 83
- MCA, 342
  - sphere, 342
- median, 86
  - wavelet, 89
  - median absolute deviation, 128
  - multiscale median transform, 86
  - pyramidal median transform, 89
- Method of Optimal Directions, 268
- Mexican hat
  - elongated, 326
  - on sphere, 326
  - wavelet, 18
- minimization
  - hybrid steepest descent, 132
- MOD, 268

- Morlet wavelet, 18
- morphological
  - component, 199
  - component analysis, 208
  - diversity, 7, 197
  - filter, 86
- MP3, 3
- MPEG, 3
- multichannel dictionary, 240
- multiresolution analysis, 22
- multiresolution support, 131
- multiscale median transform, 86
- mutual information, 237
- needlet filters, 321
- noise, 126, 127, 128, 139, 140
  - Anscombe transformation, 139
  - Gaussian, 127, 139
  - median absolute deviation, 128
  - multiplicative, 137
  - Poisson, 139, 140
  - variance stabilization, 139
- noiselets, 376
- Nonnegative Matrix Factorization, 258
- opening, 84, 93
- orthogonal wavelet, 26
- overcomplete, 6
- p-value, 127
- Parseval relation, 45, 98
- POCS, 65
- projections onto convex sets, 65
- pseudo-polar FFT, 99, 104
- PSNR, 50
- pyramid, 67, 70
  - Laplacian, 67
- pyramidal median transform, 89
- quadrature mirror filters, 26, 34
- quincunx analysis, 29
- Radon transform, 98, 288
- redundant wavelet transform, 45
- restoration, image, 8
- restricted isometry property, 377
- ridgelet, 97, 338
  - sphere, 338
- ridgelet transform, 6, 94
  - 3D, 287
  - continuous, 96
  - discrete 3D, 288, 289
  - fast slant stack, 102, 338
  - orthonormal finite, 101
  - rectopolar, 98
- scalogram, 20
- shearlet, 115
- Sobolev space, 105
- sparse regularization, 223
- sparsity, 1, 2
  - blind source separation, 240
  - multichannel data, 240
- sphere, 321
  - curvelet, 336
  - Haar, 324
  - Mexican hat, 326
  - pyramidal curvelet, 340
  - pyramidal wavelet, 334, 370
  - ridgelet, 338
  - undecimated wavelet, 329
- spherical harmonics, 323
- starlet, 61
  - second generation, 61
- starlet wavelet transform, 45, 53, 91, 279, 281
- stationary signal, 5
- super-resolution, 155
- SURE, 131
- texture, 215
- thresholding, 210
  - hard, 129, 130
  - iterative, 64, 131
  - MAD, 211
  - MOM, 211
  - soft, 129, 130
  - SURE, 131
  - universal threshold, 131
- total variation, 132, 217
- transform
  - 3D curvelet, 296
  - Anscombe transformation, 139
  - BeamCurvelet, 297, 298, 300
  - beamlet, 290, 294
  - curvelet, 105
  - FastCurvelet, 310
  - Fisz transform, 140
  - Fourier-Bessel, 351
  - G transform, 84
  - Haar transform, 140
  - mathematical morphology , 85
  - median-wavelet transform, 89
  - Meyer, 307
  - multiscale median transform, 86
  - pyramidal mathematical morphology, 85
  - pyramidal median transform, 89
  - Radon, 98, 288
  - RidCurvelet, 297, 301, 302
  - ridgelet, 96, 288
  - spherical Bessel, 352
  - spherical Fourier-Bessel, 352
  - surfacelet, 316
  - wavelet, 16
- undecimated wavelet transform, 46
- universal threshold, 131

428 Index

- variance stabilization, 139
- wavelet, 16, 275, 321
  - à trous, 45, 86, 280
  - 2D-1D, 282
  - 3D, 275
  - axisymmetrical wavelets, 325
  - biorthogonal 3D, 277, 278
  - biorthogonal 7/9 filters, 26
  - biorthogonal Haar, 141
  - biorthogonal transform, 24
  - complex transform, 51
  - continuous transform, 5, 16, 21
  - Daubechies, 26, 33
  - directional wavelets, 326
  - discrete transform, 22
  - filter bank, 57
  - Haar, 20, 59, 81, 140, 217
  - Haar on sphere, 324
  - hard threshold, 130
  - integer transform, 80
  - isotropic 3D, 279
  - isotropic wavelet transform, 53
  - mathematical morphology, 85
  - median, 89
  - Mexican hat, 18, 326
  - Mexican hat on sphere, 326
  - Meyer, 307
  - Morlet, 18, 327
  - packets, 34
  - partially decimated, 49
  - pyramidal transform, 67, 334
  - redundant transform, 45
  - scalogram, 20
  - significant coefficient, 126
  - soft threshold, 130
  - starlet, 61
  - starlet transform, 53, 86, 91
  - stereoscopic projection, 325
  - transform, 16, 31, 71, 86
  - undecimated, 46, 282
  - undecimated 3D, 279
- wavlet
  - 3-dimensional, 276